

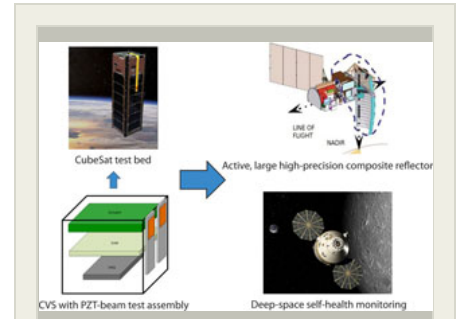
Macro-Fiber Composite-Based Actuators for Space, Phase II

Completed Technology Project (2016 - 2019)



Project Introduction

This SBIR project creates a CubeSat-based on-orbit Validation System (CVS) that provides performance and durability data for Macro Fiber Composite (MFC) piezocomposite actuators operating in space and matures this precision deployment technology through validation tests in Low Earth Orbit (LEO). NASA customers include active structures like space-based deployable telescopes. Phases I/II advance MFC actuator materials to TRL 6 or better for space. Implications of the innovation While the piezocomposites needed for active control have flown and are space qualified, their performance has not been quantified under minimal thermal protection to enable large deployable precision structures like 10 — 30 m class space telescopes. Data is needed on the viability of piezocomposites as control actuators for deployables. MFC actuators also enable structural health monitoring (SHM) methods that expand the potential commercial market. Technical objectives CVS uses a nanosatellite for LEO tests. Nanosatellites provide low-cost rapid access to space-based testing. CVS leverages our previous NASA research and builds on the Phase I TRL 5 prototype, which is defined as a CubeSat payload. Our earlier work found an unexpected deviation in the behavior of MFC actuators reacting to thermal cycles like those experienced on-orbit. This atypical behavior could cause imprecise deployment in active space structures. We established Phase II feasibility by defining and controlling this behavior. Research description Phase I developed and validated performance evaluation and thermal compensation tools for MFC actuators subjected to thermal cycling, verified weight, size, and power estimates for a flight payload, and established that CVS will fit into a CubeSat. In Phase II we deliver a flight-ready nanosatellite. Anticipated results Phase II produces a ready-to-launch TRL 6 or higher nanosatellite compatible with JPL CREAM space environmental sensors. We plan a 6-12 month LEO mission.



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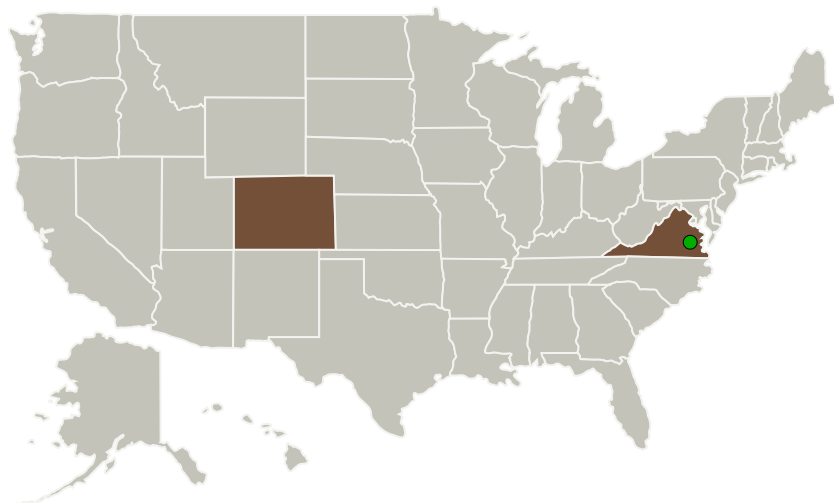
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Primary U.S. Work Locations and Key Partners



| Organizations Performing Work | Role | Type | Location |
|---------------------------------|-------------------------|-------------|-------------------|
| Extreme Diagnostics, Inc. | Lead Organization | Industry | Boulder, Colorado |
| ● Langley Research Center(LaRC) | Supporting Organization | NASA Center | Hampton, Virginia |

Primary U.S. Work Locations

| | |
|----------|----------|
| Colorado | Virginia |
|----------|----------|

Project Transitions

▶ **April 2016:** Project Start

✓ **February 2019:** Closed out

Closeout Documentation:

- Final Summary Chart(<https://techport.nasa.gov/file/139477>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Extreme Diagnostics, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Robert B Owen

Co-Investigator:

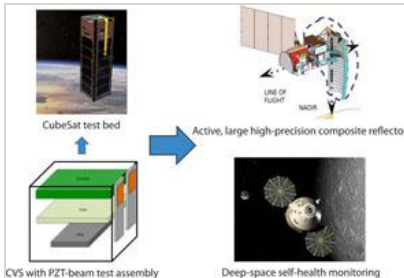
Robert Owen

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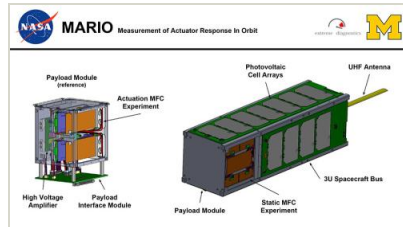


Images



Briefing Chart Image

Macro-Fiber Composite-based actuators for space, Phase II
(<https://techport.nasa.gov/image/127859>)

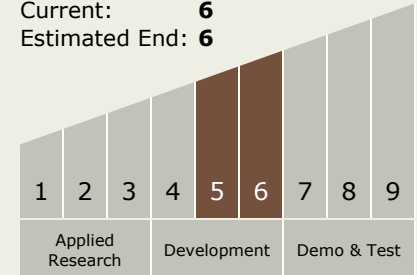


Final Summary Chart Image

Macro-Fiber Composite-Based Actuators for Space, Phase II
(<https://techport.nasa.gov/image/127824>)

Technology Maturity (TRL)

Start: 5
Current: 6
Estimated End: 6



Technology Areas

Primary:

- TX08 Sensors and Instruments
 - TX08.1 Remote Sensing Instruments/Sensors
 - TX08.1.3 Optical Components

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System